

*Suffolk County Vector Control &
Wetlands Management Long Term
Plan & Environmental Impact
Statement*



Steve Levy, County Executive

**FINAL GENERIC
ENVIRONMENTAL IMPACT
STATEMENT**

Volume 5 of 5

Appendices 8 thru 12

Prepared for:

**Suffolk County Department of
Environment and Energy**

Suffolk County Department of Health Services

Suffolk County Department of Public Works

Suffolk County, New York

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October 2006



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**SUFFOLK COUNTY VECTOR CONTROL AND WETLANDS MANAGEMENT
LONG - TERM PLAN AND ENVIRONMENTAL IMPACT STATEMENT**

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APPENDIX 8

Traced Computation of a Risk Assessment Value

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GUIDANCE FOR RECREATING CALCULATIONS PRESENTED IN THE HUMAN HEALTH RISK ASSESSMENT, TASK EIGHT, IMPACT ASSESSMENT, SUFFOLK COUNTY VECTOR CONTROL AND WETLAND MANAGEMENT PLAN

1. Introduction

This appendix is designed to guide the reader in following the series of computations that were made to characterize the potential for adverse health effects documented in the Human Health Risk Assessment (HHRA) portion of the Task 8 Report. This guide has been structured to focus on a single receptor group and document the equations and variables used to evaluate the potential for adverse noncancer health effects throughout the HHRA for hypothetical but plausible upper-bound exposures to a vector control agent. The adult community gardener was selected as the receptor group to portray in this appendix as they were evaluated in the potential dose comparison and both the screening-level (Tier I) and refined (Tier II) human health risk assessments which make-up the quantitative components of the HHRA.

2. Comparison of Potential Doses for Receptor Populations Considered in the Chronic Risk Assessment

The potential dose comparison was conducted so as to focus the HHRA on the most significant receptor groups. Table D-1 of the Report lists each of the receptor groups identified for the HHRA and the pathways by which they could be exposed to the mosquito control agent following application. The comparison uses the child resident receptor to identify receptors that could have an even greater exposure for the same pathway. The child receptor was selected as the comparison point because they were evaluated for every exposure pathway identified for the HHRA, and they are typically one of the most sensitive receptor groups. If all exposure pathways for a particular receptor group have a lower potential dose than the child resident, then the child resident can serve as a conservative surrogate for that group. The emphasis is placed on the word all in the previous sentence because if any pathway for a particular group led to a greater dose than the child resident, then the receptor group was retained for evaluation in the Tier I screening-level risk assessment. For example, of the six exposure pathways identified for the adult community gardener, only the produce ingestion pathway led to a higher dose than estimated for the child resident. Yet all six of the exposure pathways were evaluated for the adult community gardener as a means to track the overall potential for adverse health impacts for the receptor group.

Appendix E of the Report provides a details on the rationale, methodology and results of the potential dose analysis. The remainder of this section provides details of the calculations used in the comparison of the potential dose for the adult community gardener versus the child resident. The steps outlined below can be applied to any of the other receptor groups identified

in the study area to yield the potential dose results summary shown in the Report in Appendix E, Table E-2.

Step 1:

Table D-1 in Appendix D of the Report shows the receptor pathways that were considered relevant for the thirteen potential receptor populations identified in the study area. For the adult community gardener the following six exposure pathways were considered relevant as indicated by the dot shown on the table under the column marked **Community Gardener Adult**:

- Incidental ingestion of surface soil;
- Dermal contact with surface soil;
- Ingestion of residues on hands via contact with other surfaces;
- Dermal contact with residues on hands via contact with other surfaces;
- Ingestion of produce; and,
- Inhalation of residues on airborne particulate.

Step 2:

Appendix D of the Report provides an exhibit listing the dose equation for each of these pathways. It also provides a description of the exposure pathways and associated dose equations and variables. Table E-1 in Appendix E of the Report provides a listing of the exposure parameters needed for the dose equations for all thirteen receptor populations with the exception of some chemical-specific values that are listed in Appendix D. The potential dose calculations do not require use of the exposure point concentration as it assumed to be the same for all of the receptor populations. Therefore, although actual dose calculations made in the Tier I and Tier II risk assessments included an exposure point concentration, the potential dose comparison will omit that variable.

Step 3:

This step provides details on the calculation of the potential dose comparison for the adult community gardener and the child resident for the **Incidental ingestion of surface soil pathway**. The comparison is based on the dose equation listed in Exhibit D-1 of Appendix D of the Report. The relative bioavailability factor (RBA) in the dose equation was set at a value of one for both the adult community gardener and the young child resident. See Section 6.3 of HHRA Appendix D in the Report for further details on this factor. The concentration of chemical in soil represents the exposure point concentration for the exposure pathway and was omitted from the calculation along with the related unit conversion factor shown in the equation on Exhibit D-1. The potential dose for the adult community gardener and the child resident were calculated as follows.

$$PD_{soiling} = \frac{IR_{soil} * EF * ED * RBA}{AT * BW}$$

Whereby

- PD_{soiling} = potential average daily dose from incidental ingestion of soil (mg/kg-day)
- IR_{soil} = soil ingestion rate (mg/day)
- EF = exposure frequency for soil (days/year)
- ED = exposure duration (years)
- RBA = relative bioavailability factor (unitless)
 = **1** for all receptor groups evaluated.
- AT = averaging time (days)
- BW = body weight (kg)

Parameter Values and Calculated Potential Dose for Incidental Ingestion of Surface Soil

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
PD _{soiling}	0.08	mg/kg-day	Calculated via equation above and values below.
IR _{soil}	50	mg/day	The values can be found in Table E-1 of HHRA Appendix E in the Report under the RME column for the Adult Community Gardener. Note that for the potential dose calculations the exposure frequency (EF) value for Davis Park was used as discussed in HHRA Appendix E of the Report.
EF	43	days/year	
ED	30	years	
RBA	1	unitless	
AT	10,950	days	
BW	72	kg	
Young Child Resident			
PD _{soiling}	5.6	mg/kg-day	Calculated via equation above and values below.
IR _{soil}	200	mg/day	The values can be found in Table E-1 of HHRA Appendix E in the Report under the RME column for the Young Child Resident. Note that for the potential dose calculations the exposure frequency (EF) value for Davis Park was used as discussed in HHRA Appendix E of the Report.
EF	152	days/year	
ED	6	years	
RBA	1	unitless	
AT	2,190	days	
BW	15	kg	

The relative potential dose (RPD) for the adult community gardener versus the young child resident was calculated as the ratio of the individual potential doses shown above as follows:

$$RPD = \frac{0.08 (mg / kg - day)}{5.6 (mg / kg - day)} * 100 = 1\%$$

This value for the RPD can be found in Table E-2 of HHRA Technical Appendix E in the Report under the column marked Adult Community Gardener for the row marked Incidental ingestion

of surface soil. The resulting RPD was less than 100% indicating that the potential dose for an adult community gardener was lower than the value for the child resident for this pathway. Thus the child resident would be a conservative surrogate for the adult community gardener via this pathway.

Step 4:

This step provides details on the calculation of the potential dose comparison for the adult community gardener and the child resident for the **Dermal contact with surface soil pathway**. The comparison is based on the dose equation listed in Exhibit D-2 of Appendix D of the Report. The concentration of chemical in soil represents the exposure point concentration for the exposure pathway and was omitted from the calculation along with the related unit conversion factor shown in the absorbed dose per event equation (DA_{event}) on Exhibit D-2. The potential dose for the adult community gardener and the child resident were calculated as follows.

$$PD_{soil\ dermal} = \frac{DA_{event} * SA * EF * ED * EV}{AT * BW}$$

Whereby

- $PD_{soil\ dermal}$ = potential dermal absorbed dose (mg/kg-day)
- DA_{event} = absorbed dose per event (mg/cm²)
- SA = skin surface area available for contact (cm²)
- EF = exposure frequency (days/year)
- ED = exposure duration (years)
- EV = event frequency (day⁻¹)
- AT = averaging time (days)
- BW = body weight (kg)

And,

$$DA_{event} = AF * ABS_d = AF * 0.1$$

Whereby

- DA_{event} = absorbed dose per event (mg/cm²)
- AF = adherence factor (mg/cm²)
- ABS_d = dermal absorption fraction, chemical-specific (unitless)
- = **0.1** for all agents evaluated. See Table D-2 of HHRA Appendix D of Report for details.

Parameter Values and Calculated Potential Dose for Dermal Contact with Surface Soil

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
PD _{soil ing}	0.08	mg/kg-day	Calculated via equation above and values below.
DA _{event}	0.007	mg/cm ²	Calculated via equation above and values below
AF	0.07	mg/cm ²	The values can be found in Table E-1 of HHRA Appendix E in the Report under the RME column for the Adult Community Gardener. Note that for the potential dose calculations the exposure frequency (EF) value for Davis Park was used as discussed in HHRA Appendix E of the Report.
SA _{exposed}	6,878	cm ²	
EF	43	days/year	
ED	30	years	
EV	1	day ⁻¹	
AT	10,950	days	
BW	72	kg	
Young Child Resident			
PD _{soil ing}	1.6	mg/kg-day	Calculated via equation above and values below.
DA _{event}	0.02	mg/cm ²	Calculated via equation above and values below
AF	0.2	mg/cm ²	The values can be found in Table E-1 of HHRA Appendix E in the Report under the RME column for the Young Child Resident. Note that for the potential dose calculations the exposure frequency (EF) value for Davis Park was used as discussed in HHRA Appendix E of the Report.
SA	2,927	cm ²	
EF	152	days/year	
ED	6	years	
EV	1	day ⁻¹	
AT	2,190	days	
BW	15	kg	

The relative potential dose (RPD) for the adult community gardener versus the young child resident was calculated as the ratio of the individual potential doses shown above as follows:

$$RPD = \frac{0.08 (mg / kg - day)}{1.6 (mg / kg - day)} * 100 = 5\%$$

This value for the RPD can be found in Table E-2 of HHRA Technical Appendix E in the Report under the column marked Adult Community Gardener for the row marked Dermal contact with surface soil. The resulting RPD was less than 100% indicating that the potential dose for an adult community gardener was lower than the value for the child resident for this pathway. Thus the child resident would be a conservative surrogate for the adult community gardener via this pathway.

Step 5:

This step provides details on the calculation of the potential dose comparison for the adult community gardener and the child resident for the **Ingestion of residues on Hands via Surfaces**. The comparison is based on the dose equation listed in Exhibit D-3 of Appendix D of the Report. The concentration of chemical on surfaces represents the exposure point

concentration for the exposure pathway and was omitted from the calculation of potential dose. The potential dose for the adult community gardener and the child resident were calculated as follows.

$$PD_{\text{surface ing}} = \frac{SA * TC * ES * EF * ED * EV}{AT * BW} = \frac{SA * 0.2 * 0.5 * EF * ED * EV}{AT * BW}$$

Whereby

- PD_{surface ing} = potential average daily dose from ingestion of residues on hands via surfaces (mg/kg-day)
- SA = skin surface area (cm²)
- TC = hand transfer coefficient, chemical-specific (unitless)
 = **0.2** for all chemicals evaluated in HHRA, see Section 6.3 of HHRA Appendix D for further details.
- ES = extraction by saliva, chemical-specific (unitless)
 = **0.5** for all chemicals evaluated in HHRA, see Section 6.3 of HHRA Appendix D for further details.
- EF = exposure frequency for surfaces (days/year)
- ED = exposure duration (years)
- EV = event frequency (day⁻¹)
- AT = averaging time (days)
- BW = body weight (kg)

**Parameter Values and Calculated Potential Dose for
 Incidental Ingestion of Residues on Hands via Surfaces**

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
PD _{surface ing}	0.15	mg/kg-day	Calculated via equation above and values below.
SA	904	cm ²	The values can be found in Table E-1 of HHRA Appendix E in the Report under the RME column for the Adult Community Gardener. Note that for the potential dose calculations the exposure frequency (EF) value for Davis Park was used as discussed in HHRA Appendix E of the Report.
EF	43	days/year	
ED	30	years	
EV	1	day ⁻¹	
AT	10,950	days	
BW	72	kg	
Young Child Resident			
PD _{surface ing}	1.0	mg/kg-day	Calculated via equation above and values below.
SA	363	cm ²	The values can be found in Table E-1 of HHRA Appendix E in the Report under the RME column for the Young Child Resident. Note that for the potential dose calculations the exposure frequency (EF) value for Davis Park was used as discussed in HHRA Appendix E of the Report.
EF	152	days/year	
ED	6	years	
EV	1	day ⁻¹	
AT	2,190	days	
BW	15	kg	

The relative potential dose (RPD) for the adult community gardener versus the young child resident was calculated as the ratio of the individual potential doses shown above as follows:

$$RPD = \frac{0.15 (mg / kg - day)}{1.0 (mg / kg - day)} * 100 = 15 \%$$

This value for the RPD can be found in Table E-2 of HHRA Technical Appendix E in the Report under the column marked Adult Community Gardener for the row marked Incidental ingestion of residues on hands via surfaces. The resulting RPD was less than 100% indicating that the potential dose for an adult community gardener was lower than the value for the child resident for this pathway. Thus the child resident would be a conservative surrogate for the adult community gardener via this pathway.

Step 6:

This step provides details on the calculation of the potential dose comparison for the adult community gardener and the child resident for the **Dermal contact with Surfaces**. The comparison is based on the dose equation listed in Exhibit D-4 of Appendix D of the Report. The concentration of chemical on surfaces represents the exposure point concentration for the exposure pathway and was omitted from the calculation of potential dose. The potential dose for the adult community gardener and the child resident were calculated as follows.

$$PD_{\text{surface dermal}} = \frac{ABS_d * SA * TC * EF * ED * EV}{AT * BW} = \frac{0.1 * SA * 0.2 * EF * ED * EV}{AT * BW}$$

Whereby

- PD_{surface dermal} = potential dermal absorbed dose from residues on hands via surfaces (mg/kg-day)
- ABS_d = chemical-specific dermal absorption factor (unitless)
 = **0.1** for all agents evaluated. See Table D-2 of HHRA Appendix D of Report for details.
- SA = skin surface area (cm²)
- TC = hand transfer coefficient, chemical-specific (unitless)
 = **0.2** for all chemicals evaluated in HHRA, see Section 6.3 of HHRA Appendix D for further details.
- EF = exposure frequency for surfaces (days/year)
- ED = exposure duration (years)
- EV = event frequency (day⁻¹)
- AT = averaging time (days)
- BW = body weight (kg)

Parameter Values and Calculated Potential Dose for Dermal Contact with Surfaces

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
PD _{surface dermal}	0.03	mg/kg-day	Calculated via equation above and values below.
SA	904	cm ²	The values can be found in Table E-1 of HHRA Appendix E in the Report under the RME column for the Adult Community Gardener. Note that for the potential dose calculations the exposure frequency (EF) value for Davis Park was used as discussed in HHRA Appendix E of the Report.
EF	43	days/year	
ED	30	years	
EV	1	day ⁻¹	
AT	10,950	days	
BW	72	kg	
Young Child Resident			
PD _{surface dermal}	0.20	mg/kg-day	Calculated via equation above and values below.
SA	363	cm ²	The values can be found in Table E-1 of HHRA Appendix E in the Report under the RME column for the Young Child Resident. Note that for the potential dose calculations the exposure frequency (EF) value for Davis Park was used as discussed in HHRA Appendix E of the Report.
EF	152	days/year	
ED	6	years	
EV	1	day ⁻¹	
AT	2,190	days	
BW	15	kg	

The relative potential dose (RPD) for the adult community gardener versus the young child resident was calculated as the ratio of the individual potential doses shown above as follows:

$$RPD = \frac{0.03 (mg / kg - day)}{0.20 (mg / kg - day)} * 100 = 15 \%$$

This value for the RPD can be found in Table E-2 of HHRA Technical Appendix E in the Report under the column marked Adult Community Gardener for the row marked Dermal contact with surfaces. The resulting RPD was less than 100% indicating that the potential dose for an adult community gardener was lower than the value for the child resident for this pathway. Thus the child resident would be a conservative surrogate for the adult community gardener via this pathway.

Step 7:

This step provides details on the calculation of the potential dose comparison for the adult community gardener and the child resident for the **Ingestion of homegrown produce**. The comparison is based on the dose equation listed in Exhibit D-9 of Appendix D of the Report. The concentration of chemical in produce represents the exposure point concentration for the exposure pathway and was omitted from the calculation of potential dose along with the associated unit conversion factor. The potential dose for the adult community gardener and the child resident were calculated as follows

$$PD_{veg} = \frac{IR_{veg} * EF * ED * FI}{AT * CF}$$

Whereby

- PD_{veg} = average daily dose from ingestion of produce (g/kg-day)
- IR_{veg} = produce ingestion rate (g/kg-day, as consumed)
- EF = exposure frequency (days/year)
- ED = exposure duration (years)
- FI = fractional intake from potentially contaminated source (unitless)
- AT = averaging time (days)

Parameter Values

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
PD _{produce ing}	8.12	g/kg-day	Calculated via equation above and values below.
IR _{veg}	19.5	g/kg-day	USEPA 1997, Tables 9-3 and 9-4
EF	152	days/year	Assumes daily exposure, 5-month spray season
ED	30	years	USEPA 1997, Chapter 15
FI	1.0	unitless	USEPA 1997, Table 13-71
AT	10,950	days	AT = ED x 365 day/year
Residential Child			
PD _{produce ing}	2.63	g/kg-day	Calculated via equation above and values below.
IR _{veg}	45.1	g/kg-day	USEPA 1997, Tables 9-3 and 9-4
EF	152	days/year	Assumes daily exposure, 5-month spray season
ED	6	years	USEPA 1989
FI	0.14	unitless	USEPA 1997, Table 13-71
AT	2,190	days	AT = ED x 365 day/year

The relative potential dose (RPD) for the adult community gardener versus the young child resident was calculated as the ratio of the individual potential doses shown above as follows:

$$RPD = \frac{8.12 (g / kg - day)}{2.63 (g / kg - day)} * 100 = 309 \%$$

This value for the RPD can be found in Table E-2 of HHRA Technical Appendix E in the Report under the column marked Adult Community Gardener for the row marked Ingestion of homegrown produce. The resulting RPD was greater than 100% indicating that the potential dose for an adult community gardener was greater than the value for the child resident for this pathway. Thus the child resident would not be a conservative surrogate for the adult

community gardener via this pathway and the adult community gardener was retained for evaluation in the Tier I HHRA.

Step 8:

This step provides details on the calculation of the potential dose comparison for the adult community gardener and the child resident for the **Inhalation of particulates in air**. The comparison is based on the effective exposure concentration equation listed in Exhibit D-11 of Appendix D of the Report. The concentration of chemical in airborne particulate represents the exposure point concentration for the exposure pathway and was omitted from the calculation of potential dose. The potential dose for the adult community gardener and the child resident were calculated as follows

$$EEC = \frac{C_{part} * EF * ED}{AT}$$

Whereby

- EEC = effective exposure concentration (mg/m³)
- EF = exposure frequency for inhalation of impacted ambient air (days/year)
- ED = exposure duration (years)
- AT = averaging time (days)

Parameter Values

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
EEC	0.12	mg/m ³	Calculated via equation above and values below.
EF	43	days/year	The values can be found in Table E-1 of HHRA Appendix E in the Report under the RME column for the Adult Community Gardener. Note that for the potential dose calculations the exposure frequency (EF) value for Davis Park was used as discussed in HHRA Appendix E of the Report.
ED	30	years	
AT	10,950	days	
Young Child Resident			
EEC	0.42	mg/m ³	Calculated via equation above and values below.
EF	152	days/year	The values can be found in Table E-1 of HHRA Appendix E in the Report under the RME column for the Young Child Resident. Note that for the potential dose calculations the exposure frequency (EF) value for Davis Park was used as discussed in HHRA Appendix E of the Report.
ED	6	years	
AT	2,190	days	

The relative potential dose (RPD) for the adult community gardener versus the young child resident was calculated as the ratio of the individual potential doses shown above as follows:

$$RPD = \frac{0.118 (mg / m^3)}{0.416 (mg / m^3)} * 100 = 28 \%$$

This value for the RPD can be found in Table E-2 of HHRA Technical Appendix E in the Report under the column marked Adult Community Gardener for the row marked Inhalation of particulates. The resulting RPD was less than 100% indicating that the potential dose for an adult community gardener was lower than the value for the child resident for this pathway. Thus the child resident would be a conservative surrogate for the adult community gardener via this pathway.

3. Risk Calculations for Adult Community Gardener in the Tier I HHRA

A detailed description of the rationale and methodology used in the Tier I HHRA is provided in Appendix F of the Report. The Tier I HHRA was a screening-level evaluation that was conducted for all receptor populations that exhibited a potential dose greater than the child resident for any parallel exposure pathway. As demonstrated above in Section 2, the potential dose for the adult community gardener via the produce ingestion pathway exceeded the value for the child resident, and this receptor group was retained for evaluation in the Tier I HHRA. The example calculations for the Tier I HHRA will focus on the adult community gardener. The same approach can be used for any of the four receptor populations evaluated in the Tier I HHRA (i.e., young child resident, adult resident, young child park visitor, and older child park visitors).

The Tier I HHRA estimated potential human health impacts for four vector control agents (i.e., Permanone, Scourge, Anvil, and malathion). The example calculations for the adult community gardener will focus on potential exposures to malathion. The only difference in the calculations for the other three vector control agents is in the exposure point concentration used in the dose calculation. The location in the Report of the exposure point concentrations for the other vector control agents will be identified in the following discussion of the adult community gardener exposure pathways. The remainder of this section provides details of the Tier I HHRA calculations for the adult community gardener.

Step 1:

Table D-1 in Appendix D of the Report shows the receptor pathways that were considered relevant for the thirteen potential receptor populations identified in the study area. For the adult community gardener the following six exposure pathways were evaluated as indicated by the dot shown on the table under the column marked **Community Gardener Adult**:

- Incidental ingestion of surface soil;
- Dermal contact with surface soil;
- Ingestion of residues on hands via contact with other surfaces;

- Dermal contact with residues on hands via contact with other surfaces;
- Ingestion of produce; and,
- Inhalation of residues on airborne particulate.

Step 2:

This step provides details on the calculation of the malathion hazard quotient (HQ) for the adult community gardener via the **Incidental ingestion of surface soil pathway**. Details of the calculation are presented in Exhibit F-37 in HHRA Technical Appendix F of the Report. The HQ was calculated using the equations listed at the bottom of Exhibit F-37. First the average daily dose intake factor was calculated from the relevant exposure parameters as follows:

$$ADD_{if} = \frac{IR_{soil} * EF * ED}{AT * BW * CF}$$

Whereby

- ADD_{if} = average daily dose intake factor from incidental ingestion of soil (1/day)
- IR_{soil} = soil ingestion rate (mg/day)
- EF = exposure frequency for soil (days/year)
- ED = exposure duration (years)
- AT = averaging time (days)
- BW = body weight (kg)
- CF = unit conversion factor (mg/kg)

**Parameter Values and Calculated Average Daily Intake Factor
 for Incidental Ingestion of Malathion in Surface Soil**

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
ADD _{if}	8.18E-8	1/day	Calculated via equation above and values below. These values can be found in Exhibit F-37 of HHRA Technical Appendix F of the Report. They are discussed in HHRA Technical Appendix D and shown in Table E-1 of HHRA Technical Appendix E of the Report under the RME column for the Adult Community Gardener, with the exception of the parameter CF.
IR _{soil}	50	mg/day	
EF	43	days/year	
ED	30	years	
AT	10,950	days	
BW	72	kg	
CF	1.00E+06	mg/kg	

Next the average daily dose for the pathway due to malathion exposure was calculated by combining the ADD_{if} with the malathion exposure point concentration in soil and any chemical-specific exposure parameters as follows.

$$ADD_{soiling} = C_{soil} * RBA * ADD_{if}$$

Whereby

- ADD_{soiling} = average daily dose from incidental ingestion of malathion in soil (mg/kg-day)
 C_{soil} = concentration of malathion in soil (mg/kg)
 RBA = relative bioavailability factor for malathion (unitless)
 ADD_{if} = average daily dose intake factor, (1/day)

**Parameter Values and Calculated Average Daily Dose for
 Incidental Ingestion of Malathion in Surface Soil**

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
ADD _{soiling}	2.34E-07	mg/kg-day	Calculated via equation above and values below. Shown in the first table of Exhibit F-37 of HHRA Technical Appendix F under the column marked ADD RME for the row marked malathion in the Chemicals of Potential Concern column.
C _{soil}	2.86	mg/kg	Shown in the first table of Exhibit F-37 of HHRA Technical Appendix F under the column marked C _{soil} for the row marked malathion in the Chemicals of Potential Concern column. The rationale and methodology for C _{soil} exposure point concentrations in the Tier I HHRA is presented in HHRA Technical Appendix A of the Report, and the values are listed in Table A-6 of the appendix.
RBA	1	unitless	Shown in the first table of Exhibit F-37 of HHRA Technical Appendix F under the column marked RBA for the row marked malathion in the Chemicals of Potential Concern column. See Section 6.3 of HHRA Technical Appendix D in the Report for further information.
ADD _{if}	8.18E-08	1/day	Shown in Exhibit F-37 of HHRA Technical Appendix F at the bottom of the table of Exposure Parameter and Assumptions.

Finally the HQ was calculated as the ratio of the average daily dose (ADD) and the malathion chronic oral reference dose (RfD) as follows.

$$HQ_{soil\ ing} = \frac{ADD_{soil\ ing}}{RfD}$$

Whereby

- $HQ_{soil\ ing}$ = hazard quotient for adult community gardener due to malathion exposure via incidental ingestion of soil (unitless)
- $ADD_{soil\ ing}$ = average daily dose from incidental ingestion of malathion in soil (mg/kg-day)
- RfD = chronic oral reference dose for malathion (mg/kg-day)

**Parameter Values and Calculated Hazard Quotient for
 Incidental Ingestion of Malathion in Surface Soil**

Parameters	Value	Units	Source
Adult Community Gardener			
HQ	1.17E-05	unitless	Calculated via equation above and values shown below. Also shown in the first table of Exhibit F-37 of HHRA Technical Appendix F under the column marked HQ RME for the row marked malathion in the Chemicals of Potential Concern column.
$ADD_{soil\ ing}$	2.34E-07	mg/kg-day	Calculated via equation and values discussed earlier in this step. Also shown in the first table of Exhibit F-37 of HHRA Technical Appendix F under the column marked ADD RME for the row marked malathion in the Chemicals of Potential Concern column.
RfD	2.00E-02	mg/kg-day	Shown in the first table of Exhibit F-37 of HHRA Technical Appendix F under the column marked Chronic Oral RfD for the row marked malathion in the Chemicals of Potential Concern column. The rationale and methodology for the Oral RfDs is presented in HHRA Technical Appendix B of the Report, and the values are listed in Table B-1 of the appendix in the row for Chronic Ingestion.

Step 3:

This step provides details on the calculation of the malathion hazard quotient (HQ) for the adult community gardener via the **Dermal absorption with malathion in surface soil pathway**.

Details of the calculation are presented in Exhibit F-38 in HHRA Technical Appendix F of the Report. The HQ was calculated using the equations listed at the bottom of Exhibit F-38. First the average daily dermal absorption dose intake factor (DAD_{if}) was calculated from the relevant exposure parameters as follows:

$$DAD_{if} = \frac{EF * ED * EV * SA}{AT * BW}$$

Whereby

- DAD_{if} = average daily dermal absorption dose intake factor for contact with malathion in soil (cm²-event/kg-day)
- EF = exposure frequency for dermal contact with soil (days/year)
- ED = exposure duration (years)
- EV = frequency of dermal contact with soil (events/day)
- SA = skin surface area in contact with soil during event (cm²)
- AT = averaging time (days)
- BW = body weight (kg)

**Parameter Values and Calculated Average Daily Intake Factor
 for Dermal Contact with Malathion in Surface Soil**

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
DAD _{if}	1.13E+01	cm ² -event/ kg-day	Calculated via equation above and values below.
EF	43	days/year	These values can be found in Exhibit F-38 of HHRA Technical Appendix F of the Report. They are discussed in HHRA Technical Appendix D and shown in Table E-1 of HHRA Technical Appendix E of the Report under the RME column for the Adult Community Gardener.
ED	30	years	
EV	1	event/day	
SA	6,878	cm ²	
AT	10,950	days	
BW	72	kg	

Next the amount of malathion absorbed per event via dermal contact with surface soil as follows.

$$DA_{event} = C_{soil} * CF * AF * ABS_d$$

Whereby

- DA_{event} = malathion absorbed per event via dermal contact with surface soil (mg/cm²-event)
 C_{soil} = concentration of malathion in soil (mg/kg)
 CF = unit conversion factor (kg/mg)
 AF = adherence factor (mg/cm²-event)
 ABS_d = malathion dermal absorption fraction (unitless)

**Parameter Values and Calculated Malathion Absorption per Event for
 Dermal Contact with Malathion in Surface Soil**

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
DA_{event}	2.00E-08	mg/cm ² -event	Calculated via equation above and values below. Shown in the first table of Exhibit F-38 of HHRA Technical Appendix F under the column marked DA_{event} RME for the row marked malathion in the Chemicals of Potential Concern column.
C_{soil}	2.86	mg/kg	Shown in the first table of Exhibit F-38 of HHRA Technical Appendix F under the column marked C_{soil} for the row marked malathion in the Chemicals of Potential Concern column. The rationale and methodology for C_{soil} exposure point concentrations in the Tier I HHRA is presented in HHRA Technical Appendix A of the Report, and the values are listed in Table A-6 of the appendix.
CF	1.0E-06	unitless	Shown in the bottom table of Exposure Parameter and Assumptions in Exhibit F-38 of HHRA Technical Appendix F in the Report.
AF	0.07	mg/cm ² -event	Shown in Exhibit F-38 of HHRA Technical Appendix F in the bottom of the table of Exposure Parameter and Assumptions. This value is discussed in Section 6.2.3 of HHRA Technical Appendix D and shown in Table E-1 of HHRA Technical Appendix E of the Report under the RME column for the Adult Community Gardener.
ABS_d	0.1	unitless	Shown in the first table of Exhibit F-38 of HHRA Technical Appendix F under the column marked ABS_d . This value is discussed in Section 6.3 and shown in Table D-2 of HHRA Technical Appendix D of the Report.

Next the average daily dose for the pathway due was calculated by combining the average daily dermal absorption dose intake factor for contact with malathion in soil (DAD_{if}) with the amount of malathion absorbed per event via dermal contact with surface soil (DA_{event}) as follows.

$$DAD_{soil\ dermal} = DA_{event} * DAD_{if}$$

Whereby

- DAD_{soil dermal} = average daily dose from dermal contact with malathion in soil (mg/kg-day)
- DA_{event} = malathion absorbed per event via dermal contact with surface soil (mg/cm²-event)
- DAD_{if} = average daily dermal absorption dose intake factor for contact with malathion in soil (cm²-event/kg-day)

Parameter Values and Calculated Average Daily Dose for Dermal Contact with Surface Soil

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
DAD _{soil dermal}	2.25E-07	mg/kg-day	Calculated via equation above and values below. Shown in the first table of Exhibit F-38 of HHRA Technical Appendix F under the column marked DAD RME for the row marked malathion in the Chemicals of Potential Concern column.
DA _{event}	2.00E-08	mg/cm ² -event	Calculated via equation and values discussed earlier in this step. Also shown in the first table of Exhibit F-38 of HHRA Technical Appendix F under the column marked DA _{event} RME for the row marked malathion in the Chemicals of Potential Concern column.
DAD _{if}	1.13E+01	cm ² -event/kg-day	Calculated via equation and values discussed earlier in this step. Also shown in Exhibit F-38 of HHRA Technical Appendix F at the bottom of the table of Exposure Parameter and Assumptions.

Finally the HQ was calculated as the ratio of the average daily dose (ADD) and the malathion chronic oral reference dose (RfD) as follows.

$$HQ_{\text{soil dermal}} = \frac{DAD_{\text{soil dermal}}}{RfD}$$

Whereby

- HQ_{soil dermal} = hazard quotient for adult community gardener due to malathion exposure via dermal contact with soil (unitless)
- DAD_{soil dermal} = average daily dose from dermal contact with malathion in soil (mg/kg-day)
- RfD = chronic dermal reference dose for malathion (mg/kg-day)

**Parameter Values and Calculated Hazard Quotient for
 Dermal Contact with Malathion in Surface Soil**

Parameters	Value	Units	Source
Adult Community Gardener			
HQ _{soil dermal}	1.13E-05	unitless	Calculated via equation above and values shown below. Also shown in the first table of Exhibit F-38 of HHRA Technical Appendix F under the column marked HQ RME for the row marked malathion in the Chemicals of Potential Concern column.
DAD _{soil dermal}	2.25E-07	mg/kg-day	Calculated via equation and values discussed earlier in this step. Also shown in the first table of Exhibit F-38 of HHRA Technical Appendix F under the column marked DAD RME for the row marked malathion in the Chemicals of Potential Concern column.
RfD	2.00E-02	mg/kg-day	Shown in the first table of Exhibit F-38 of HHRA Technical Appendix F under the column marked Chronic Dermal RfD for the row marked malathion in the Chemicals of Potential Concern column. The rationale and methodology for the Dermal RfDs is presented in HHRA Technical Appendix B of the Report, and the values are listed in Table B-1 of the appendix in the row for Chronic Dermal.

Step 4:

This step provides details on the calculation of the malathion hazard quotient (HQ) for the adult community gardener via the **Incidental ingestion of residues on surfaces pathway**. Details of the calculation are presented in Exhibit F-39 in HHRA Technical Appendix F of the Report. The HQ was calculated using the equations listed at the bottom of Exhibit F-39. First the average daily dose intake factor was calculated from the relevant exposure parameters as follows:

$$ADD_{if} = \frac{TC * ES * SA * EF * ED * EV}{AT * BW}$$

Whereby

- ADD_{if} = average daily dose intake factor from incidental ingestion of residues on surfaces (cm²/kg-day)
 TC = hand transfer coefficient (unitless)
 ES = extraction by saliva (unitless)
 SA = skin surface area (cm²)
 EF = exposure frequency for ingestion of residues (days/year)
 ED = exposure duration (years)
 EV = event frequency (day⁻¹)
 AT = averaging time (days)
 BW = body weight (kg)

**Parameter Values and Calculated Average Daily Intake Factor
 for Incidental Ingestion of Residue on Surfaces**

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
ADD _{if}	1.48E-01	cm ² /kg-day	Calculated via equation above and values below.
TC	0.2	unitless	These values are shown in Exhibit F-39 of HHRA Technical Appendix F in the table of Exposure Parameter and Assumptions. See Section 6.3 of HHRA Technical Appendix D of the Report for further details. These values can be found in the table of Exposure Assumptions and Parameters of Exhibit F-39 in HHRA Technical Appendix F of the Report. They are discussed in HHRA Technical Appendix D and shown in Table E-1 of HHRA Technical Appendix E of the Report under the RME column for the Adult Community Gardener.
ES	0.5	unitless	
SA	904	cm ²	
EF	43	days/year	
ED	30	years	
EV	1	1/days	
AT	10,950	days	
BW	72	kg	

Next the average daily dose for the pathway due to malathion exposure was calculated by combining the ADD_{if} with the malathion exposure point concentration on surfaces as follows.

$$ADD_{sfc\ ing} = C_{surfaces} * ADD_{if}$$

Whereby

- $ADD_{sfc\ ing}$ = average daily dose from incidental ingestion of malathion residues on surfaces (mg/kg-day)
 $C_{surface}$ = concentration of malathion on inorganic surfaces (mg/cm²)
 ADD_{if} = average daily dose intake factor, (cm²/kg-day)

**Parameter Values and Calculated Average Daily Dose for
 Incidental Ingestion of Malathion Residue on Inorganic Surfaces**

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
$ADD_{sfc\ ing}$	5.97E-03	mg/kg-day	Calculated via equation above and values below. Shown in the first table of Exhibit F-39 of HHRA Technical Appendix F under the column marked ADD RME for the row marked malathion in the Chemicals of Potential Concern column.
$C_{surface}$	4.04E-02	mg/cm ²	Shown in the first table of Exhibit F-39 of HHRA Technical Appendix F under the column marked $C_{surface}$ for the row marked malathion in the Chemicals of Potential Concern column. The rationale and methodology for $C_{surface}$ exposure point concentrations in the Tier I HHRA is presented in HHRA Technical Appendix A of the Report, and the values are listed in Table A-6 of the appendix.
ADD_{if}	1.48E-01	cm ² /kg-day	Calculated via equation and values discussed earlier in this step. Also shown in Exhibit F-39 of HHRA Technical Appendix F at the bottom of the table of Exposure Parameter and Assumptions.

Finally the HQ was calculated as the ratio of the average daily dose (ADD) and the malathion chronic oral reference dose (RfD) as follows.

$$HQ_{sfc\ ing} = \frac{ADD_{sfc\ ing}}{RfD}$$

Whereby

- HQ_{soil ing} = hazard quotient for adult community gardener due to malathion exposure via incidental ingestion of soil (unitless)
- ADD_{sfc ing} = average daily dose from incidental ingestion of malathion in soil (mg/kg-day)
- RfD = chronic oral reference dose for malathion (mg/kg-day)

**Parameter Values and Calculated Hazard Quotient for
 Incidental Ingestion of Malathion Residues on Inorganic Surfaces**

Parameters	Value	Units	Source
Adult Community Gardener			
HQ	2.99E-01	unitless	Calculated via equation above and values shown below. Also shown in the first table of Exhibit F-39 of HHRA Technical Appendix F under the column marked HQ RME for the row marked malathion in the Chemicals of Potential Concern column.
ADD _{soil ing}	5.97E-03	mg/kg-day	Calculated via equation and values discussed earlier in this step. Also shown in the first table of Exhibit F-39 of HHRA Technical Appendix F under the column marked ADD RME for the row marked malathion in the Chemicals of Potential Concern column.
RfD	2.00E-02	mg/kg-day	Shown in the first table of Exhibit F-39 of HHRA Technical Appendix F under the column marked Chronic Oral RfD for the row marked malathion in the Chemicals of Potential Concern column. The rationale and methodology for the Oral RfDs is presented in HHRA Technical Appendix B of the Report, and the values are listed in Table B-1 of the appendix in the row for Chronic Ingestion.

Step 5:

This step provides details on the calculation of the malathion hazard quotient (HQ) for the adult community gardener via the **Dermal absorption of malathion residues on inorganic surfaces**. Details of the calculation are presented in Exhibit F-40 in HHRA Technical Appendix F of the Report. The HQ was calculated using the equations listed at the bottom of Exhibit F-40. First the average daily dermal absorption dose intake factor (DAD_{if}) was calculated from the relevant exposure parameters as follows:

$$DAD_{if} = \frac{TC * SA * EF * ED * EV}{AT * BW}$$

Whereby

- DAD_{if} = average daily dermal absorption dose intake factor for contact with malathion residues on inorganic surfaces (cm²-event/kg-day)
- TC = hand transfer coefficient (unitless)
- SA = skin surface area in contact with surface during event (cm²)
- EF = exposure frequency for dermal contact with surfaces (days/year)
- ED = exposure duration (years)
- EV = frequency of dermal contact with surfaces (events/day)
- AT = averaging time (days)
- BW = body weight (kg)

**Parameter Values and Calculated Average Daily Intake Factor
 for Dermal Contact with Malathion Residues on Inorganic Surfaces**

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
DAD _{if}	2.96E-01	cm ² / kg-day	Calculated via equation above and values below.
TC	0.2	Unitless	This value is shown in Exhibit F-40 of HHRA Technical Appendix F in the table of Exposure Parameter and Assumptions. See Section 6.3 of HHRA Technical Appendix D of the Report for further details.
SA	904	cm ²	These values can be found in the table of Exposure Parameters and Assumptions on Exhibit F-40 of HHRA Technical Appendix F of the Report. They are discussed in HHRA Technical Appendix D and shown in Table E-1 of HHRA Technical Appendix E of the Report under the RME column for the Adult Community Gardener.
EF	43	days/year	
ED	30	years	
EV	1	event/day	
AT	10,950	days	
BW	72	kg	

Next the average daily dose for the pathway was calculated by combining the average daily dermal absorption dose intake factor for contact with malathion residues on inorganic surfaces (DAD_{if}) with the malathion concentration on the inorganic surface (C_{surface}) and the dermal absorption factor (ABS_d) as follows.

$$ADD_{sfc\ dermal} = C_{surface} * ABS_d * DAD_{if}$$

Whereby

- $ADD_{sfc\ dermal}$ = average daily dose from dermal contact with malathion residues on inorganic surfaces (mg/kg-day)
 $C_{surface}$ = concentration of malathion on inorganic surfaces (mg/cm²)
 ABS_d = dermal absorption factor for malathion (unitless)
 DAD_{if} = average daily dermal absorption dose intake factor for contact with malathion in soil (cm²-event/kg-day)

**Parameter Values and Calculated Average Daily Dose for
 Dermal Contact with Malathion Residues on Inorganic Surfaces**

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
$ADD_{sfc\ dermal}$	1.19E-03	mg/kg-day	Calculated via equation above and values below. Shown in the first table of Exhibit F-40 of HHRA Technical Appendix F under the column marked ADD RME for the row marked malathion in the Chemicals of Potential Concern column.
$C_{surface}$	4.04E-02	mg/cm ²	Shown in the first table of Exhibit F-40 of HHRA Technical Appendix F under the column marked $C_{surface}$ for the row marked malathion in the Chemicals of Potential Concern column. The rationale and methodology for $C_{surface}$ exposure point concentrations in the Tier I HHRA is presented in HHRA Technical Appendix A of the Report, and the values are listed in Table A-6 of the appendix.
ABS_d	0.1	unitless	Shown in the first table of Exhibit F-40 of HHRA Technical Appendix F under the column marked ABS_d . This value is discussed in Section 6.3 and shown in Table D-2 of HHRA Technical Appendix D of the Report.
DAD_{if}	2.96E-01	cm ² / kg-day	Calculated via equation and values discussed earlier in this step. Also shown in Exhibit F-40 of HHRA Technical Appendix F at the bottom of the table of Exposure Parameter and Assumptions.

Finally the HQ was calculated as the ratio of the average daily dose (ADD) and the malathion chronic oral reference dose (RfD) as follows.

$$HQ_{sfc\ dermal} = \frac{ADD_{sfc\ dermal}}{RfD}$$

Whereby

HQ_{soil dermal} = hazard quotient for adult community gardener due to exposure via dermal contact with malathion residues on inorganic surfaces (unitless)
 ADD_{sfc dermal} = average daily dose from dermal contact with malathion residues on inorganic surfaces (mg/kg-day)
 RfD = chronic dermal reference dose for malathion (mg/kg-day)

**Parameter Values and Calculated Hazard Quotient for
 Dermal Contact with Malathion Residues on Inorganic Surfaces**

Parameters	Value	Units	Source
Adult Community Gardener			
HQ _{sfc dermal}	5.97E-02	unitless	Calculated via equation above and values shown below. Also shown in the first table of Exhibit F-40 of HHRA Technical Appendix F under the column marked HQ RME for the row marked malathion in the Chemicals of Potential Concern column.
ADD _{sfc dermal}	1.19E-03	mg/kg-day	Calculated via equation and values discussed earlier in this step. Also shown in the first table of Exhibit F-40 of HHRA Technical Appendix F under the column marked ADD RME for the row marked malathion in the Chemicals of Potential Concern column.
RfD	2.00E-02	mg/kg-day	Shown in the first table of Exhibit F-40 of HHRA Technical Appendix F under the column marked Chronic Dermal RfD for the row marked malathion in the Chemicals of Potential Concern column. The rationale and methodology for the Dermal RfDs is presented in HHRA Technical Appendix B of the Report, and the values are listed in Table B-1 of the appendix in the row for Chronic Dermal.

Step 6:

This step provides details on the calculation of the malathion hazard quotient (HQ) for the adult community gardener via the **Ingestion of homegrown produce**. Details of the calculation are presented in Exhibit F-41 in HHRA Technical Appendix F of the Report. The HQ was calculated using the equations listed at the bottom of Exhibit F-41. First the average daily dose intake factor (ADD_{if}) was calculated from the relevant exposure parameters as follows:

$$ADD_{if} = \frac{IR * FI * EF * ED}{AT * CF}$$

Whereby

ADD _{if}	=	average daily dose intake factor for ingestion of produce (1/day)
IR	=	produce ingestion rate (g/kg-day, as consumed)
FI	=	fractional intake from potentially contaminated source (unitless)
EF	=	exposure frequency for ingestion of homegrown produce (days/year)
ED	=	exposure duration (years)
AT	=	averaging time (days)
CF	=	unit conversion factor (g/kg)

**Parameter Values and Calculated Average Daily Intake Factor
 for Ingestion of Homegrown Produce**

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
ADD _{if}	8.12E-03	1/day	Calculated via equation above and values below. These values can be found in the table of Exposure Parameters and Assumptions on Exhibit F-41 of HHRA Technical Appendix F of the Report. They are discussed in HHRA Technical Appendix D and shown in Table E-1 of HHRA Technical Appendix E of the Report under the RME column for the Adult Community Gardener. Shown in table of Exposure Assumptions and Parameters in Exhibit F-41 of HHRA Technical Appendix F in the Report.
IR	19.5	g/kg-day	
FI	1	unitless	
EF	152	days/year	
ED	30	years	
AT	10,950	days	
CF	1.00E+03	g/kg	

Next the average daily dose for the pathway was calculated by combining the average daily dose intake factor for ingestion of homegrown produce (ADD_{if}) with the malathion concentration in produce/vegetables (C_{veg}) as follows.

$$ADD_{ing\ produce} = C_{veg} * ADD_{if}$$

Whereby

- $ADD_{ing\ produce}$ = average daily dose from ingestion of malathion in homegrown produce (mg/kg-day)
 C_{veg} = concentration of malathion in homegrown produce (mg/kg)
 ADD_{if} = average daily dose intake factor for ingestion of homegrown produce (1/day)

**Parameter Values and Calculated Average Daily Dose for
 Ingestion of Malathion in Homegrown Produce**

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
$ADD_{ing\ produce}$	1.44E-01	mg/kg-day	Calculated via equation above and values below. Shown in the first table of Exhibit F-41 of HHRA Technical Appendix F under the column marked ADD RME for the row marked malathion in the Chemicals of Potential Concern column.
C_{veg}	1.77E+01	mg/kg	Shown in the first table of Exhibit F-41 of HHRA Technical Appendix F under the column marked C_{veg} for the row marked malathion in the Chemicals of Potential Concern column. The rationale and methodology for C_{veg} exposure point concentrations in the Tier I HHRA is presented in HHRA Technical Appendix A of the Report, and the values are listed under the column Produce in Table A-6 of the appendix.
ADD_{if}	8.12E-03	1/day	Calculated via equation and values discussed earlier in this step. Also shown in Exhibit F-41 of HHRA Technical Appendix F at the bottom of the table of Exposure Parameter and Assumptions.

Finally the HQ was calculated as the ratio of the average daily dose for the produce ingestion pathway ($ADD_{ing\ produce}$) and the malathion chronic oral reference dose (RfD) as follows.

$$HQ_{ing\ produce} = \frac{ADD_{ing\ produce}}{RfD}$$

Whereby

- $HQ_{ing\ produce}$ = hazard quotient for adult community gardener due to ingestion of malathion in homegrown produce (unitless)
- $ADD_{ing\ produce}$ = average daily dose from ingestion of malathion in homegrown produce (mg/kg-day)
- RfD = chronic dermal reference dose for malathion (mg/kg-day)

Parameter Values and Calculated Hazard Quotient for Ingestion of Malathion in Homegrown Produce

Parameters	Value	Units	Source
Adult Community Gardener			
$HQ_{ing\ produce}$	7.19E+00	unitless	Calculated via equation above and values shown below. Also shown in the first table of Exhibit F-41 of HHRA Technical Appendix F under the column marked HQ RME for the row marked malathion in the Chemicals of Potential Concern column.
$ADD_{ing\ produce}$	1.44E-01	mg/kg-day	Calculated via equation and values discussed earlier in this step. Also shown in the first table of Exhibit F-41 of HHRA Technical Appendix F under the column marked ADD RME for the row marked malathion in the Chemicals of Potential Concern column.
RfD	2.00E-02	mg/kg-day	Shown in the first table of Exhibit F-41 of HHRA Technical Appendix F under the column marked Chronic Oral RfD for the row marked malathion in the Chemicals of Potential Concern column. The rationale and methodology for the Oral RfDs is presented in HHRA Technical Appendix B of the Report, and the values are listed in Table B-1 of the appendix in the row for Chronic Oral.

Step 7

This step provides details on the calculation of the malathion hazard quotient (HQ) for the adult community gardener via **Inhalation of particulates in air**. Details of the calculation are presented in Exhibit F-42 in HHRA Technical Appendix F of the Report. The HQ was calculated using the equations listed at the bottom of Exhibit F-42. First the effective exposure concentration (EEC) intake factor was calculated from the relevant exposure parameters as follows.

$$EEC_{if} = \frac{EF * ED}{AT}$$

Whereby

- EEC_{if} = effective exposure concentration intake factor for inhalation of particulates in air (unitless)
- EF = exposure frequency for inhalation of particulates in air (days/year)
- ED = exposure duration (years)
- AT = averaging time (days)

**Parameter Values and Calculated Effective Exposure Concentration Intake Factor
 for Inhalation of Particulates in Air**

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
EEC _{if}	1.18E-01	unitless	Calculated via equation above and values below.
EF	43	g/kg-day	These values can be found in the table of Exposure Parameters and Assumptions on Exhibit F-42 of HHRA Technical Appendix F of the Report. They are discussed in HHRA Technical Appendix D and shown in Table E-1 of HHRA Technical Appendix E of the Report under the RME column for the Adult Community Gardener.
ED	30	unitless	
AT	10,950	days/year	

Next the malathion effective exposure concentration was calculated by combining the effective exposure concentration daily dose intake factor (EEC_{if}) for inhalation of particulates in air with the malthion concentration in airborne particulates (C_{part}) as follows.

$$EEC = C_{part} * EEC_{if}$$

Whereby

- EEC = effective exposure concentration for malathion in airborne particulates (mg/m³)
- C_{part} = concentration of malathion in airborne particulates (mg/m³)
- EEC_{if} = effective exposure concentration daily dose intake factor for inhalation of particulates in air (unitless)

**Parameter Values and Calculated Effective Exposure Concentration for
 Inhalation of Malathion on Airborne Particulates**

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
EEC	1.55E-08	mg/m ³	Calculated via equation above and values below. Shown in the first table of Exhibit F-42 of HHRA Technical Appendix F under the column marked EEC RME for the row marked malathion in the Chemicals of Potential Concern column.
C _{part}	1.32E-07	mg/m ³	Shown in the first table of Exhibit F-42 of HHRA Technical Appendix F under the column marked C _{part} for the row marked malathion in the Chemicals of Potential Concern column. The rationale and methodology for C _{part} exposure point concentrations in the Tier I HHRA is presented in HHRA Technical Appendix A of the Report, and the values are listed under the column Airborne PM10 in Table A-6 of the appendix.
EEC _{if}	1.18E-01	unitless	Calculated via equation and values discussed earlier in this step. Also shown in Exhibit F-42 of HHRA Technical Appendix F at the bottom of the table of Exposure Parameter and Assumptions.

Finally the HQ was calculated as the ratio of the effective exposure concentration for malathion in airborne particulates (EEC) and the malathion chronic inhalation reference concentration (RfC) as follows.

$$HQ_{inh\ part} = EEC / RfC$$

Whereby

- HQ_{inh particulate} = hazard quotient for adult community gardener due to inhalation of malathion in airborne particulates (unitless)
- EEC = effective exposure concentration for malathion on airborne particulates (mg/m³)
- RfC = chronic inhalation reference concentration for malathion (mg/m³)

**Parameter Values and Calculated Hazard Quotient for
 Inhalation of Malathion on Airborne Particulates**

Parameters	Value	Units	Source
Adult Community Gardener			
HQ _{inh particulate}	7.75E-7	unitless	Calculated via equation above and values shown below. Also shown in the first table of Exhibit F-42 of HHRA Technical Appendix F under the column marked HQ RME for the row marked malathion in the Chemicals of Potential Concern column.
EEC	1.55E-08	mg/m ³	Calculated via equation and values discussed earlier in this step. Also shown in the first table of Exhibit F-42 of HHRA Technical Appendix F under the column marked EEC RME for the row marked malathion in the Chemicals of Potential Concern column
RfC	2.00E-02	mg/m ³	Shown in the first table of Exhibit F-42 of HHRA Technical Appendix F under the column marked Chronic Inhalation RfC _i for the row marked malathion in the Chemicals of Potential Concern column. The rationale and methodology for the Inhalation RfCs is presented in HHRA Technical Appendix B of the Report, and the values are listed in Table B-1 of the appendix in the row for Chronic Inhalation RfCs.

4. Risk Calculations for Adult Community Gardener in the Tier II HHRA

A detailed description of the rationale and methodology used in the Tier II HHRA is provided in HHRA Technical Appendix G of the Report. The Tier II HHRA was a refined evaluation that was conducted for all receptor populations and vector control agents that exhibited the potential for an adverse health effect in the Tier I HHRA. As discussed in Section 3 of the HHRA Technical Appendix F of the Report, only exposures to young child residents and the adult community gardener suggested a potential for adverse health effects due to malathion. The example calculations for the Tier II HHRA will focus on the adult community gardener. The same approach can be used for the young child resident evaluated in the Tier II HHRA.

The Tier II HHRA estimated potential human health impacts at four study areas (i.e., Dix Hills, Manorville, Davis Park and Mastic Shirley). The example calculations for the adult community gardener will focus on potential exposures in the Davis Park study area. The only difference in the calculations for the other study areas was the value used for the malathion soil concentration. The Tier II HHRA also evaluated a central tendency (CT) and reasonable maximum exposure (RME) case for each of the study areas. The example calculations will focus

on the RME case. The difference in the calculations is based on the values used for the exposure assumptions and parameters for each pathway. The location in the Report of the exposure point concentrations for other study areas will be identified in the following discussion of the adult community gardener exposure pathways along with the location of the relevant values for the exposure assumptions and factors used for the CT and RME cases. The remainder of this section provides details of the Tier II HHRA calculations for the adult community gardener.

Step 1:

Table D-1 in Appendix D of the Report shows the receptor pathways that were considered relevant for the thirteen potential receptor populations identified in the study area. For the adult community gardener the following six exposure pathways were evaluated as indicated by the dot shown on the table under the column marked **Community Gardener Adult**:

- Incidental ingestion of surface soil;
- Dermal contact with surface soil;
- Ingestion of residues on hands via contact with other surfaces;
- Dermal contact with residues on hands via contact with other surfaces;
- Ingestion of produce; and,
- Inhalation of residues on airborne particulate.

Step 2:

This step provides details on the calculation of the malathion hazard quotient (HQ) for the adult community gardener via the **Incidental ingestion of surface soil pathway**. Details of the calculation are presented in Exhibit G-12 in HHRA Technical Appendix G of the Report. The HQ was calculated using the equations listed at the bottom of Exhibit G-12. First the average daily dose intake factor was calculated from the relevant exposure parameters as follows:

$$ADD_{if} = \frac{IR_{soil} * EF * ED}{AT * BW * CF}$$

Whereby

ADD _{if}	=	average daily dose intake factor from incidental ingestion of soil (1/day)
IR _{soil}	=	soil ingestion rate (mg/day)
EF	=	exposure frequency for soil (days/year)
ED	=	exposure duration (years)
AT	=	averaging time (days)
BW	=	body weight (kg)
CF	=	unit conversion factor (mg/kg)

**Parameter Values and Calculated Average Daily Intake Factor
 for Incidental Ingestion of Malathion in Surface Soil**

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
ADD _{if}	8.18E-8	1/day	Calculated via equation above and values below for the Davis Park study area and the RME case. These values can be found in the Exposure Assumptions and Parameters table of Exhibit G-12 of HHRA Technical Appendix G of the Report under the RME column. The CT values are located to the left of the RME value in this table. The exposure frequency is the only variable that changes for the study areas and the relevant values can be found in the Exposure Assumptions and Parameters table of Exhibit G-12 of HHRA Technical Appendix G of the Report. All of these values are discussed in HHRA Technical Appendix D and shown in Table E-1 of HHRA Technical Appendix E of the Report under the RME column for the Adult Community Gardener, with the exception of the parameter CF.
IR _{soil}	50	mg/day	
EF	43	days/year	
ED	30	years	
AT	10,950	days	
BW	72	kg	
CF	1.00E+06	mg/kg	

Next the average daily dose for the pathway due to malathion exposure was calculated by combining the ADD_{if} with the malathion exposure point concentration in soil and any chemical-specific exposure parameters as follows.

$$ADD_{soiling} = C_{soil} * RBA * ADD_{if}$$

Whereby

- ADD_{soiling} = average daily dose from incidental ingestion of malathion in soil (mg/kg-day)
- C_{soil} = concentration of malathion in soil (mg/kg)
- RBA = relative bioavailability factor for malathion (unitless)
- ADD_{if} = average daily dose intake factor, (1/day)

**Parameter Values and Calculated Average Daily Dose for
 Incidental Ingestion of Malathion in Surface Soil**

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
ADD _{soil ing}	8.51E-08	mg/kg-day	Calculated via equation above and values below. Shown in the first table of Exhibit G-12 of HHRA Technical Appendix G under the column marked ADD RME for the row marked Davis Park in the Study Area column.
C _{soil}	1.04E+00	mg/kg	Shown in the first table of Exhibit G-12 of HHRA Technical Appendix G under the column marked C _{soil} RME for the row marked Davis Park in the Study Area column. The rationale and methodology for C _{soil} exposure point concentrations in the Tier II HHRA is presented in HHRA Technical Appendix A of the Report, and the values are listed in Table A-11 of the appendix.
RBA	1	unitless	Shown in the first table of Exhibit G-12 of HHRA Technical Appendix G under the column marked RBA for the row marked Davis Park in the Study Area column. See Section 6.3 of HHRA Technical Appendix D in the Report for further information.
ADD _{if}	8.18E-08	1/day	Calculated via equation and values discussed earlier in this step. Also shown in Exhibit G-12 of HHRA Technical Appendix G at the bottom of the table of Exposure Parameter and Assumptions.

Finally the HQ was calculated as the ratio of the average daily dose (ADD) and the malathion chronic oral reference dose (RfD) as follows.

$$HQ_{soil\ ing} = \frac{ADD_{soil\ ing}}{RfD}$$

Whereby

- HQ_{soil ing} = hazard quotient for adult community gardener due to malathion exposure via incidental ingestion of soil (unitless)
- ADD_{soil ing} = average daily dose from incidental ingestion of malathion in soil (mg/kg-day)
- RfD = chronic oral reference dose for malathion (mg/kg-day)

**Parameter Values and Calculated Hazard Quotient for
 Incidental Ingestion of Malathion in Surface Soil**

Parameters	Value	Units	Source
Adult Community Gardener			
HQ	4.25E-06	unitless	Calculated via equation above and values shown below. Also shown in the first table of Exhibit G-12 of HHRA Technical Appendix G under the column marked HQ RME for the row marked Davis Park in the Study Area column.
ADD _{soil ing}	8.51E-08	mg/kg-day	Calculated via equation and values discussed earlier in this step. Also shown in the first table of Exhibit G-12 of HHRA Technical Appendix G under the column marked ADD RME for the row marked Davis Park in the Study Area column.
RfD	2.00E-02	mg/kg-day	Shown in the first table of Exhibit G-12 of HHRA Technical Appendix G under the column marked Chronic Oral RfD for the row marked Davis Park in the Study Area column. The rationale and methodology for the Oral RfDs is presented in HHRA Technical Appendix B of the Report, and the values are listed in Table B-1 of the appendix in the row for Chronic Ingestion.

Step 3:

This step provides details on the calculation of the malathion hazard quotient (HQ) for the adult community gardener via the **Dermal absorption with malathion in surface soil pathway**.

Details of the calculation are presented in Exhibit G-13 in HHRA Technical Appendix G of the Report. The HQ was calculated using the equations listed at the bottom of Exhibit G-13. First the average daily dermal absorption dose intake factor (DAD_{if}) was calculated from the relevant exposure parameters as follows:

$$DAD_{if} = \frac{EF * ED * EV * SA}{AT * BW}$$

Whereby

- DAD_{if} = average daily dermal absorption dose intake factor for contact with malathion in soil (cm²-event/kg-day)
- EF = exposure frequency for dermal contact with soil (days/year)
- ED = exposure duration (years)
- EV = frequency of dermal contact with soil (events/day)
- SA = skin surface area in contact with soil during event (cm²)
- AT = averaging time (days)
- BW = body weight (kg)

**Parameter Values and Calculated Average Daily Intake Factor
 for Dermal Contact with Malathion in Surface Soil**

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
DAD _{if}	1.13E+01	cm ² -event/ kg-day	Calculated via equation above and values below for the Davis Park study area and the RME case.
EF	43	days/year	These values can be found in Exposure Assumptions and Parameters table on Exhibit G-13 of HHRA Technical Appendix G of the Report under the RME column. The CT values are located to the left of the RME values in the table. The exposure frequency is the only variable that changes by study area, and the relevant values can be found in the same Exposure Assumptions and Parameters table on Exhibit G-13. The values are discussed in HHRA Technical Appendix D and shown in Table E-1 of HHRA Technical Appendix E of the Report under the RME column for the Adult Community Gardener.
ED	30	years	
EV	1	event/day	
SA	6,878	cm ²	
AT	10,950	days	
BW	72	kg	

Next the amount of malathion absorbed per event via dermal contact with surface soil as follows.

$$DA_{event} = C_{soil} * CF * AF * ABS_d$$

Whereby

- DA_{event} = malathion absorbed per event via dermal contact with surface soil (mg/cm²-event)
 C_{soil} = concentration of malathion in soil (mg/kg)
 CF = unit conversion factor (kg/mg)
 AF = adherence factor (mg/cm²-event)
 ABS_d = malathion dermal absorption fraction (unitless)

**Parameter Values and Calculated Malathion Absorption per Event for
 Dermal Contact with Malathion in Surface Soil**

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
DA_{event}	7.28E-09	mg/cm ² -event	Calculated via equation above and values below. Shown in the first table of Exhibit G-13 of HHRA Technical Appendix G under the column marked DA_{event} RME for the row marked Davis Park in the study area column.
C_{soil}	1.04E+00	mg/kg	Shown in the first table of Exhibit G-13 of HHRA Technical Appendix G under the column marked C_{soil} RME for the row marked Davis Park in the study area column. The rationale and methodology for C_{soil} exposure point concentrations in the Tier II HHRA is presented in HHRA Technical Appendix A of the Report, and the values are listed in Table A-11 of the appendix.
CF	1.0E-06	unitless	Shown in the bottom table of Exposure Parameter and Assumptions in Exhibit G-13 of HHRA Technical Appendix G in the Report.
AF	0.07	mg/cm ² -event	Shown in Exhibit G-13 of HHRA Technical Appendix G in the bottom of the table of Exposure Parameter and Assumptions. This value is discussed in Section 6.2.3 of HHRA Technical Appendix D and shown in Table E-1 of HHRA Technical Appendix E of the Report under the RME column for the Adult Community Gardener.
ABS_d	0.1	unitless	Shown in the first table of Exhibit G-13 of HHRA Technical Appendix G under the column marked ABS_d . This value is discussed in Section 6.3 and shown in Table D-2 of HHRA Technical Appendix D of the Report.

Next the average daily dose for the pathway due was calculated by combining the average daily dermal absorption dose intake factor for contact with malathion in soil (DAD_{if}) with the amount of malathion absorbed per event via dermal contact with surface soil (DA_{event}) as follows.

$$DAD_{soil\ dermal} = DA_{event} * DAD_{if}$$

Whereby

- $DAD_{soil\ dermal}$ = average daily dose from dermal contact with malathion in soil (mg/kg-day)
- DA_{event} = malathion absorbed per event via dermal contact with surface soil (mg/cm²-event)
- DAD_{if} = average daily dermal absorption dose intake factor for contact with malathion in soil (cm²-event/kg-day)

Parameter Values and Calculated Average Daily Dose for Dermal Contact with Surface Soil

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
$DAD_{soil\ dermal}$	8.19E-08	mg/kg-day	Calculated via equation above and values below. Shown in the first table of Exhibit G-13 of HHRA Technical Appendix G under the column marked DAD RME for the row marked Davis Park in the study area column.
DA_{event}	7.28E-09	mg/cm ² -event	Calculated via equation and values discussed earlier in this step. Also shown in the first table of Exhibit G-13 of HHRA Technical Appendix G under the column marked DA_{event} RME for the row marked Davis Park in the study area column.
DAD_{if}	1.13E+01	cm ² -event/kg-day	Calculated via equation and values discussed earlier in this step. Also shown in Exhibit G-13 of HHRA Technical Appendix G at the bottom of the table of Exposure Parameter and Assumptions for the Davis Park study area.

Finally the HQ was calculated as the ratio of the average daily dose (ADD) and the malathion chronic oral reference dose (RfD) as follows.

$$HQ_{\text{soil dermal}} = \frac{DAD_{\text{soil dermal}}}{RfD}$$

Whereby

- $HQ_{\text{soil dermal}}$ = hazard quotient for adult community gardener due to malathion exposure via dermal contact with soil (unitless)
- $DAD_{\text{soil dermal}}$ = average daily dose from dermal contact with malathion in soil (mg/kg-day)
- RfD = chronic dermal reference dose for malathion (mg/kg-day)

**Parameter Values and Calculated Hazard Quotient for
 Dermal Contact with Malathion in Surface Soil**

Parameters	Value	Units	Source
Adult Community Gardener			
$HQ_{\text{soil dermal}}$	4.10E-06	unitless	Calculated via equation above and values shown below. Also shown in the first table of Exhibit G-13 of HHRA Technical Appendix GF under the column marked HQ RME for the row marked Davis Park in the study areacolumn.
$DAD_{\text{soil dermal}}$	8.19E-08	mg/kg-day	Calculated via equation and values discussed earlier in this step. Also shown in the first table of Exhibit G-13 of HHRA Technical Appendix G under the column marked DAD RME for the row marked Davis Park in the study area column.
RfD	2.00E-02	mg/kg-day	Shown in the first table of Exhibit G-13 of HHRA Technical Appendix G under the column marked Chronic Dermal RfD for the row marked Davis Park in the study area column. The rationale and methodology for the Dermal RfDs is presented in HHRA Technical Appendix B of the Report, and the values are listed in Table B-1 of the appendix in the row for Chronic Dermal.

Step 4:

This step provides details on the calculation of the malathion hazard quotient (HQ) for the adult community gardener via the **Incidental ingestion of residues on surfaces pathway**. Details of the calculation are presented in Exhibit G-14 in HHRA Technical Appendix G of the Report. The HQ was calculated using the equations listed at the bottom of Exhibit G-14. First the average daily dose intake factor was calculated from the relevant exposure parameters as follows:

$$ADD_{if} = \frac{TC * ES * SA * EF * ED * EV}{AT * BW}$$

Whereby

- ADD_{if} = average daily dose intake factor from incidental ingestion of residues on surfaces (cm²/kg-day)
 TC = hand transfer coefficient (unitless)
 ES = extraction by saliva (unitless)
 SA = skin surface area (cm²)
 EF = exposure frequency for ingestion of residues (days/year)
 ED = exposure duration (years)
 EV = event frequency (day⁻¹)
 AT = averaging time (days)
 BW = body weight (kg)

**Parameter Values and Calculated Average Daily Intake Factor
 for Incidental Ingestion of Residue on Surfaces**

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
ADD _{if}	1.48E-01	cm ² /kg-day	Calculated via equation above and values below.
TC	0.2	unitless	These values are shown in Exhibit G-14 of HHRA Technical Appendix G in the table of Exposure Parameter and Assumptions. See Section 6.3 of HHRA Technical Appendix D of the Report for further details. These values can be found in the table of Exposure Assumptions and Parameters of Exhibit G-14 in HHRA Technical Appendix G of the Report under the RME column. The CT values are located to the left of the RME values in this table. The exposure frequency is the only variable that changes by study area, and the relevant values can be found in the same Exposure Assumptions and Parameters table on Exhibit G-13. All of these values are discussed in HHRA Technical Appendix D and shown in Table E-1 of HHRA Technical Appendix E of the Report under the RME column for the Adult Community Gardener.
ES	0.5	unitless	
SA	904	cm ²	
EF	43	days/year	
ED	30	years	
EV	1	1/days	
AT	10,950	days	
BW	72	kg	

Next the average daily dose for the pathway due to malathion exposure was calculated by combining the ADD_{if} with the malathion exposure point concentration on surfaces as follows.

$$ADD_{sfc\ ing} = C_{surfaces} * ADD_{if}$$

Whereby

- $ADD_{sfc\ ing}$ = average daily dose from incidental ingestion of malathion residues on surfaces (mg/kg-day)
 $C_{surface}$ = concentration of malathion on inorganic surfaces (mg/cm²)
 ADD_{if} = average daily dose intake factor, (cm²/kg-day)

**Parameter Values and Calculated Average Daily Dose for
 Incidental Ingestion of Malathion Residue on Inorganic Surfaces**

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
$ADD_{sfc\ ing}$	6.03E-04	mg/kg-day	Calculated via equation above and values below. Shown in the first table of Exhibit G-14 of HHRA Technical Appendix G under the column marked ADD RME for the row marked Davis Park in the study area column.
$C_{surface}$	4.08E-03	mg/cm ²	Shown in the first table of Exhibit G-14 of HHRA Technical Appendix G under the column marked $C_{surface}$ RME for the row marked Davis Park in the study area column. The rationale and methodology for $C_{surface}$ exposure point concentrations in the Tier II HHRA is presented in HHRA Technical Appendix A of the Report, and the values are listed in Table A-11 of the appendix.
ADD_{if}	1.48E-01	cm ² /kg-day	Calculated via equation and values discussed earlier in this step. Also shown in Exhibit F-39 of HHRA Technical Appendix F at the bottom of the table of Exposure Parameter and Assumptions.

Finally the HQ was calculated as the ratio of the average daily dose (ADD) and the malathion chronic oral reference dose (RfD) as follows.

$$HQ_{sfc\ ing} = \frac{ADD_{sfc\ ing}}{RfD}$$

Whereby

- $HQ_{soil\ ing}$ = hazard quotient for adult community gardener due to malathion exposure via incidental ingestion of soil (unitless)
- $ADD_{sfc\ ing}$ = average daily dose from incidental ingestion of malathion in soil (mg/kg-day)
- RfD = chronic oral reference dose for malathion (mg/kg-day)

**Parameter Values and Calculated Hazard Quotient for
 Incidental Ingestion of Malathion Residues on Inorganic Surfaces**

Parameters	Value	Units	Source
Adult Community Gardener			
HQ	3.01E-02	unitless	Calculated via equation above and values shown below. Also shown in the first table of Exhibit G-14 of HHRA Technical Appendix G under the column marked HQ RME for the row marked Davis Park in the study area column.
$ADD_{soil\ ing}$	6.03E-04	mg/kg-day	Calculated via equation and values discussed earlier in this step. Also shown in the first table of Exhibit G-14 of HHRA Technical Appendix G under the column marked ADD RME for the row marked Davis Park in the study area column.
RfD	2.00E-02	mg/kg-day	Shown in the first table of Exhibit G-14 of HHRA Technical Appendix G under the column marked Chronic Oral RfD for the row marked Davis Park in the study area column. The rationale and methodology for the Oral RfDs is presented in HHRA Technical Appendix B of the Report, and the values are listed in Table B-1 of the appendix in the row for Chronic Ingestion.

Step 5:

This step provides details on the calculation of the malathion hazard quotient (HQ) for the adult community gardener via the **Dermal absorption of malathion residues on inorganic surfaces**. Details of the calculation are presented in Exhibit G-15 in HHRA Technical Appendix G of the Report. The HQ was calculated using the equations listed at the bottom of Exhibit G-15. First the average daily dermal absorption dose intake factor (DAD_{if}) was calculated from the relevant exposure parameters as follows:

$$DAD_{if} = \frac{TC * SA * EF * ED * EV}{AT * BW}$$

Whereby

- DAD_{if} = average daily dermal absorption dose intake factor for contact with malathion residues on inorganic surfaces (cm²-event/kg-day)
- TC = hand transfer coefficient (unitless)
- SA = skin surface area in contact with surface during event (cm²)
- EF = exposure frequency for dermal contact with surfaces (days/year)
- ED = exposure duration (years)
- EV = frequency of dermal contact with surfaces (events/day)
- AT = averaging time (days)
- BW = body weight (kg)

**Parameter Values and Calculated Average Daily Intake Factor
 for Dermal Contact with Malathion Residues on Inorganic Surfaces**

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
DAD _{if}	2.96E-01	cm ² / kg-day	Calculated via equation above and values below.
TC	0.2	Unitless	This value is shown in Exhibit G-15 of HHRA Technical Appendix G in the table of Exposure Parameter and Assumptions. See Section 6.3 of HHRA Technical Appendix D of the Report for further details.
SA	904	cm ²	These values can be found in the table of Exposure Parameters and Assumptions on Exhibit G-15 of HHRA Technical Appendix G of the Report under the RME column. The CT values are located to the left of the RME values in this table. The exposure frequency is the only variable that changes by study area, and the relevant values can be found in the same Exposure Assumptions and Parameters table on Exhibit G-13. All of these values are discussed in HHRA Technical Appendix D and shown in Table E-1 of HHRA Technical Appendix E of the Report under the RME column for the Adult Community Gardener.
EF	43	days/year	
ED	30	years	
EV	1	event/day	
AT	10,950	days	
BW	72	kg	

Next the average daily dose for the pathway was calculated by combining the average daily dermal absorption dose intake factor for contact with malathion residues on inorganic surfaces

(DAD_{if}) with the malathion concentration on the inorganic surface (C_{surface}) and the dermal absorption factor (ABS_d) as follows.

$$ADD_{sfc\ dermal} = C_{surface} * ABS_d * DAD_{if}$$

Whereby

- ADD_{sfc dermal} = average daily dose from dermal contact with malathion residues on inorganic surfaces (mg/kg-day)
 C_{surface} = concentration of malathion on inorganic surfaces (mg/cm²)
 ABS_d = dermal absorption factor for malathion (unitless)
 DAD_{if} = average daily dermal absorption dose intake factor for contact with malathion in soil (cm²-event/kg-day)

**Parameter Values and Calculated Average Daily Dose for
 Dermal Contact with Malathion Residues on Inorganic Surfaces**

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
ADD _{sfc dermal}	1.21E-04	mg/kg-day	Calculated via equation above and values below. Shown in the first table of Exhibit G-15 of HHRA Technical Appendix G under the column marked ADD RME for the row marked Davis Park in the study area column.
C _{surface}	4.08E-03	mg/cm ²	Shown in the first table of Exhibit G-15 of HHRA Technical Appendix G under the column marked C _{surface} RME for the row marked Davis Park in the study area column. The rationale and methodology for C _{surface} exposure point concentrations in the Tier II HHRA is presented in HHRA Technical Appendix A of the Report, and the values are listed in Table A11 of the appendix.
ABS _d	0.1	unitless	Shown in the first table of Exhibit G-15 of HHRA Technical Appendix G under the column marked ABS _d . This value is discussed in Section 6.3 and shown in Table D-2 of HHRA Technical Appendix D of the Report.
DAD _{if}	2.96E-01	cm ² / kg-day	Calculated via equation and values discussed earlier in this step. Also shown in Exhibit G-15 of HHRA Technical Appendix G at the bottom of the table of Exposure Parameter and Assumptions under the RME column.

Finally the HQ was calculated as the ratio of the average daily dose (ADD) and the malathion chronic oral reference dose (RfD) as follows.

$$HQ_{sfc\ dermal} = \frac{ADD_{sfc\ dermal}}{RfD}$$

Whereby

- $HQ_{soil\ dermal}$ = hazard quotient for adult community gardener due to exposure via dermal contact with malathion residues on inorganic surfaces (unitless)
- $ADD_{sfc\ dermal}$ = average daily dose from dermal contact with malathion residues on inorganic surfaces (mg/kg-day)
- RfD = chronic dermal reference dose for malathion (mg/kg-day)

**Parameter Values and Calculated Hazard Quotient for
 Dermal Contact with Malathion Residues on Inorganic Surfaces**

Parameters	Value	Units	Source
Adult Community Gardener			
$HQ_{sfc\ dermal}$	6.03E-03	unitless	Calculated via equation above and values shown below. Also shown in the first table of Exhibit G-15 of HHRA Technical Appendix G under the column marked HQ RME for the row marked Davis Park in the study area column.
$ADD_{sfc\ dermal}$	1.21E-04	mg/kg-day	Calculated via equation and values discussed earlier in this step. Also shown in the first table of Exhibit G-15 of HHRA Technical Appendix G under the column marked ADD RME for the row marked Davis Park in the study area column.
RfD	2.00E-02	mg/kg-day	Shown in the first table of Exhibit G-15 of HHRA Technical Appendix G under the column marked Chronic Dermal RfD for the row marked Davis Park in the study area column. The rationale and methodology for the Dermal RfDs is presented in HHRA Technical Appendix B of the Report, and the values are listed in Table B-1 of the appendix in the row for Chronic Dermal.

Step 6:

This step provides details on the calculation of the malathion hazard quotient (HQ) for the adult community gardener via the **Ingestion of homegrown produce**. Details of the calculation are presented in Exhibit G-16 in HHRA Technical Appendix G of the Report. The HQ was calculated using the equations listed at the bottom of Exhibit G-16. First the average daily dose intake factor (ADD_{if}) was calculated from the relevant exposure parameters as follows:

$$ADD_{if} = \frac{IR * FI * EF * ED}{AT * CF}$$

Whereby

- ADD_{if} = average daily dose intake factor for ingestion of produce (1/day)
- IR = produce ingestion rate (g/kg-day, as consumed)
- FI = fractional intake from potentially contaminated source (unitless)
- EF = exposure frequency for ingestion of homegrown produce (days/year)
- ED = exposure duration (years)
- AT = averaging time (days)
- CF = unit conversion factor (g/kg)

**Parameter Values and Calculated Average Daily Intake Factor
 for Ingestion of Homegrown Produce**

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
ADD _{if}	8.12E-03	1/day	Calculated via equation above and values below.
IR	19.5	g/kg-day	These values can be found in the table of Exposure Parameters and Assumptions on Exhibit G-16 of HHRA Technical Appendix G of the Report under the RME column. The CT values are located to the left of the RME values in this table. The exposure frequency is the only variable that changes by study area, and the relevant values can be found in the same Exposure Assumptions and Parameters table on Exhibit G-13. All of these values are discussed in HHRA Technical Appendix D and shown in Table E-1 of HHRA Technical Appendix E of the Report under the RME column for the Adult Community Gardener. Shown in table of Exposure Assumptions and Parameters in Exhibit G-16 of HHRA Technical Appendix G in the Report.
FI	1	unitless	
EF	152	days/year	
ED	30	years	
AT	10,950	days	
CF	1.00E+03	g/kg	

Next the average daily dose for the pathway was calculated by combining the average daily dose intake factor for ingestion of homegrown produce (ADD_{if}) with the malathion concentration in produce/vegetables (C_{veg}) as follows.

$$ADD_{ing\ produce} = C_{veg} * ADD_{if}$$

Whereby

- ADD_{ing produce} = average daily dose from ingestion of malathion in homegrown produce (mg/kg-day)

C_{veg} = concentration of malathion in homegrown produce (mg/kg)
 ADD_{if} = average daily dose intake factor for ingestion of homegrown produce (1/day)

**Parameter Values and Calculated Average Daily Dose for
 Ingestion of Malathion in Homegrown Produce**

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
$ADD_{ing\ produce}$	5.19E-02	mg/kg-day	Calculated via equation above and values below. Shown in the first table of Exhibit G-16 of HHRA Technical Appendix G under the column marked ADD RME for the row marked Davis Park in the study area column.
C_{vag}	6.40E+00	mg/kg	Shown in the first table of Exhibit G-16 of HHRA Technical Appendix G under the column marked C_{veg} RME for the row marked Davis Park in the study area column. The rationale and methodology for C_{veg} exposure point concentrations in the Tier II HHRA is presented in HHRA Technical Appendix A of the Report, and the values are listed under the column Produce in Table A-11 of the appendix.
ADD_{if}	8.12E-03	1/day	Calculated via equation and values discussed earlier in this step. Also shown in Exhibit G-16 of HHRA Technical Appendix G at the bottom of the table of Exposure Parameter and Assumptions under the RME case.

Finally the HQ was calculated as the ratio of the average daily dose for the produce ingestion pathway ($ADD_{ing\ produce}$) and the malathion chronic oral reference dose (RfD) as follows.

$$HQ_{ing\ produce} = \frac{ADD_{ing\ produce}}{RfD}$$

Whereby

- HQ_{ing produce} = hazard quotient for adult community gardener due to ingestion of malathion in homegrown produce (unitless)
- ADD_{ing produce} = average daily dose from ingestion of malathion in homegrown produce (mg/kg-day)
- RfD = chronic dermal reference dose for malathion (mg/kg-day)

Parameter Values and Calculated Hazard Quotient for Ingestion of Malathion in Homegrown Produce

Parameters	Value	Units	Source
Adult Community Gardener			
HQ _{ing produce}	2.60E+00	unitless	Calculated via equation above and values shown below. Also shown in the first table of Exhibit G-16 of HHRA Technical Appendix G under the column marked HQ RME for the row marked Davis Park in the study area column.
ADD _{ing produce}	5.19E-02	mg/kg-day	Calculated via equation and values discussed earlier in this step. Also shown in the first table of Exhibit G-16 of HHRA Technical Appendix G under the column marked ADD RME for the row marked Davis Park in the study area column.
RfD	2.00E-02	mg/kg-day	Shown in the first table of Exhibit G-16 of HHRA Technical Appendix G under the column marked Chronic Oral RfD for the row marked Davis Park in the study area column. The rationale and methodology for the Oral RfDs is presented in HHRA Technical Appendix B of the Report, and the values are listed in Table B-1 of the appendix in the row for Chronic Oral.

Step 7

This step provides details on the calculation of the malathion hazard quotient (HQ) for the adult community gardener via **Inhalation of particulates in air**. Details of the calculation are presented in Exhibit G-17 in HHRA Technical Appendix G of the Report. The HQ was calculated using the equations listed at the bottom of Exhibit G-17. First the effective exposure concentration (EEC) intake factor was calculated from the relevant exposure parameters as follows.

$$EEC_{if} = \frac{EF * ED}{AT}$$

Whereby

- EEC_{if} = effective exposure concentration intake factor for inhalation of particulates in air (unitless)
- EF = exposure frequency for inhalation of particulates in air (days/year)
- ED = exposure duration (years)
- AT = averaging time (days)

Parameter Values and Calculated Effective Exposure Concentration Intake Factor for Inhalation of Particulates in Air

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
EEC _{if}	1.18E-01	unitless	Calculated via equation above and values below.
EF	43	g/kg-day	These values can be found in the table of Exposure Parameters and Assumptions on Exhibit G-17 of HHRA Technical Appendix G of the Report under the RME column. The CT values are located to the left of the RME values in this table. The exposure frequency is the only variable that changes by study area, and the relevant values can be found in the same Exposure Assumptions and Parameters table on Exhibit G-13. All of these values are discussed in HHRA Technical Appendix D and shown in Table E-1 of HHRA Technical Appendix E of the Report under the RME column for the Adult Community Gardener.
ED	30	unitless	
AT	10,950	days/year	

Next the malathion effective exposure concentration was calculated by combining the effective exposure concentration daily dose intake factor (EEC_{if}) for inhalation of particulates in air with the malathion concentration in airborne particulates (C_{part}) as follows.

$$EEC = C_{part} * EEC_{if}$$

Whereby

- EEC = effective exposure concentration for malathion in airborne particulates (mg/m³)
- C_{part} = concentration of malathion in airborne particulates (mg/m³)
- EEC_{if} = effective exposure concentration daily dose intake factor for inhalation of particulates in air (unitless)

Parameter Values and Calculated Effective Exposure Concentration for

Inhalation of Malathion on Airborne Particulates

Exposure Parameters	Value	Units	Source
Adult Community Gardener			
EEC	5.62E-09	mg/m ³	Calculated via equation above and values below. Shown in the first table of Exhibit G-17 of HHRA Technical Appendix G under the column marked EEC RME for the row marked Davis Park in the study area column.
C _{part}	4.77E-08	mg/m ³	Shown in the first table of Exhibit G-17 of HHRA Technical Appendix G under the column marked C _{part} RME for the row marked Davis Park in the study area column. The rationale and methodology for C _{part} exposure point concentrations in the Tier II HHRA is presented in HHRA Technical Appendix A of the Report, and the values are listed under the column Airborne PM10 in Table A-11 of the appendix.
EEC _{if}	1.18E-01	unitless	Calculated via equation and values discussed earlier in this step. Also shown in Exhibit G-17 of HHRA Technical Appendix G at the bottom of the table of Exposure Parameter and Assumptions for the Davis Park RME case.

Finally the HQ was calculated as the ratio of the effective exposure concentration for malathion in airborne particulates (EEC) and the malathion chronic inhalation reference concentration (RfC) as follows.

$$HQ_{inh\ part} = EEC / RfC$$

Whereby

- HQ_{inh particulate} = hazard quotient for adult community gardener due to inhalation of malathion in airborne particulates (unitless)
- EEC = effective exposure concentration for malathion on airborne particulates (mg/m³)
- RfC = chronic inhalation reference concentration for malathion (mg/m³)

**Parameter Values and Calculated Hazard Quotient for
 Dermal Contact with Malathion Residues on Inorganic Surfaces**

Parameters	Value	Units	Source
Adult Community Gardener			
HQ _{inh particulate}	2.81E-7	unitless	Calculated via equation above and values shown below. Also shown in the first table of Exhibit G-17 of HHRA Technical Appendix G under the column marked HQ RME for the row marked Davis Park in the study area column.
EEC	5.62E-09	mg/m ³	Calculated via equation and values discussed earlier in this step. Also shown in the first table of Exhibit G-17 of HHRA Technical Appendix G under the column marked EEC RME for the row marked Davis Park in the study area column
RfC	2.00E-02	mg/m ³	Shown in the first table of Exhibit G-17 of HHRA Technical Appendix G under the column marked Chronic Inhalation RfC _i for the row marked Davis Park in the study area column. The rationale and methodology for the Inhalation RfCs is presented in HHRA Technical Appendix B of the Report, and the values are listed in Table B-1 of the appendix in the row for Chronic Inhalation RfCs.